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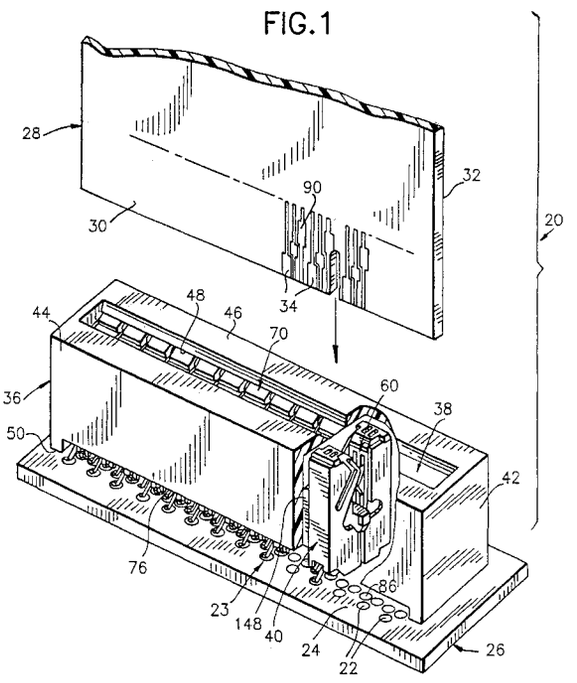
(54) High speed card edge connectors

(57) An electrical connector (200) comprising a frame (204), at least one first connector module (212) and at least one different second connector module (214). The frame (204) has at least one connector module receiving area (218) adapted to receive a plurality of connector modules (212, 214). The frame (204) comprises a first array of connector module locating features (226) and a different second array of connector module locating features (226). The first connector module (212) is located in the at least one receiving area (218, 220). The first connector module (212) has a housing (228) and electrical contacts (230). The first connector module (212) comprises a mating first array of positioning features interlocked with at least a portion of the first array of locating features (226) in the frame (204). The different second connector module (214) is located in the at least one receiving area (218, 220). The second connector module (214) has a housing (228) and electrical contacts (230). The second connector module (214) comprises a mating different second array of positionig features (240) interlocked with at least a portion of the second array of locating features (226) in the frame (204).

FIG.1



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Description

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This is continuation-in-part patent application of copending application No. 09/474,818 filed December 29, 1999, which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to modular electrical connectors and, more particularly, to card edge connectors with modular inserts.

2. Discussion of Earlier Developments

[0003] Electrical connectors assembled from a plurality of connector modules are well known in the art. Card edge connectors for connecting an edge of a printed circuit board to another electronic component are also well known in the art. There is a desire to provide an electrical connector which can be assembled from a combination of connector modules from distinct groups of different types of connector modules, which can allow intra-group interchangeable selection and assembly in a predetermined area, but prevent inter-groups interchangeable selection and assembly of connector module from different groups.

SUMMARY OF THE INVENTION

[0004] In accordance with one embodiment of the present invention, an electrical connector is provided comprising a frame, at least one first connector module and at least one different second connector module. The frame has at least one connector module receiving area adapted to receive a plurality of connector modules. The frame comprises a first array of connector module locating features and a different second array of connector module locating features. The first connector module is located in the at least one receiving area. The first connector module has a housing and electrical contacts. The first connector module comprises a mating first array of positioning features interlocked with at least a portion of the first array of locating features in the frame. The different second connector module is located in the at least one receiving area. The second connector module has a housing and electrical contacts. The second connector module comprises a mating different second array of positioning features interlocked with at least a portion of the second array of locating features in the frame.

[0005] In accordance with another embodiment of the present invention an electrical connector is provided comprising a frame, at least one first connector module located in a first receiving area of the frame, and at least one second connector module or first connector module located in a second receiving area of the frame. The frame has a first connector module receiving area and a spaced second connector module receiving area. Each receiving area is adapted to receive at least two connector modules. The second receiving area is adapted to receive at least two different connector modules. The at least one first connector module is located in the first receiving area. The at least one second connector module or first connector module is located in the second receiving area. The connector can be provided with connector modules in the second receiving area with or without the second connector modules.

[0006] In accordance with one method of the present invention, a method of assembling an electrical connector is provided comprising steps of providing a frame having a connector module receiving area; selecting at least two connector modules from a plurality of different types of connector modules, each connector module having a housing and an electrical contact; and inserting the selected connector modules into the same receiving area adjacent each other, wherein the connector modules and the frame in the receiving area comprise interlocking locating features to stationarily mount the housings to the frame.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The foregoing aspects and other features of the present invention are explained in the following description, taken in connection with the accompanying drawings, wherein:

Fig. 1 is an exploded perspective view of a card edge connector assembly embodying the present invention.

Fig. 2 is a side elevation view of the card edge connector assembly illustrated in Fig. 1, certain parts being cut away and shown in section;

Fig. 3 is a top plan view of the card edge connector assembly illustrated in Figs. 1 and 2;

Fig. 4 is an end elevation view of the card edge connector assembly illustrated in Figs. 1, 2, and 3;

Fig. 5 is a perspective view of a grouping of modules according to the invention positioned on a motherboard but absent the outer frame which normally envelops the modules;

Fig 6 is a perspective view of an insulative housing for a module with elongated contacts in place;

Fig. 7 is another perspective view of the insulative housing for a module but without elongated con-

tacts being illustrated;

Fig. 8A is a front elevation view of the insulative housing illustrated in Figs. 6 and 7;

Fig. 8B is a side elevation view of the insulative housing illustrated in Figs. 6, 7, and 8A;

Fig. 8C is a rear elevation view of the insulative housing illustrated in Figs. 6, 7, 8A, and 8B;

Fig. 8D is a side elevation view, taken opposite that of Fig. 8B of the insulative housing illustrated in Figs. 6, 7, 8A, 8B, and 8C;

Fig. 9 is a perspective view illustrating opposed ground shields, each having a C-shaped cross section for slidable reception, respectively, on an outer peripheral surface of the insulative housing of Figs. 6, 7, 8A, 8B, 8C, and 8D;

Fig. 10 is a front elevation view of a module into which a planar card such as a daughter board is about to be inserted;

Fig. 11 is a side elevation view of the module illustrated in Fig. 10

Fig. 12 is a perspective view illustrating a single tubular ground shield which is another embodiment of the pair of opposed ground shields illustrated in Fig. 9;

Fig. 13 is side elevation view of a modified module which includes the single tubular ground shield illustrated in Fig. 12;

Fig. 14 is a detail view in section illustrating a portion of the outer frame provided with a variety of locating features at a plurality of longitudinally spaced locations for positioning the modules at defined spaced locations within the outer frame;

Figs. 15, 16, 17, 18, are detail section views, similar to Fig. 14, illustrating variations of the construction of Fig. 14, each illustrating a portion of the outer frame provided with a variety of different locating features at a plurality of longitudinally spaced locations, also for positioning the modules at defined spaced locations within the outer frame;

Fig. 19 is a detail exploded view in elevation illustrating a modified outer frame in which a pair of longitudinally spaced septum members are provided, each with a registration feature enabling a suitably formed planar card with conductive contact members to be fully inserted into the card receiving slot of the card edge connector assembly;

Fig. 20 is a partial perspective view with a cut away section of an electrical connector incorporating features of the present invention attached to a printed circuit board;

Fig. 21 is a schematic bottom plan view of an alternate embodiment of an electrical connector frame;

Figs. 22a-22c are schematic bottom plan views of three different first type of connector modules for use with the frame shown in Fig. 21; and

Figs. 23a-23c are schematic bottom plan views of three different second type of connector modules for use with the frame shown in Fig. 21.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0008] Referring to Fig. 1, there is shown an exploded perspective view of a card edge connector assembly 20 incorporating features of the present invention. Although the present invention will be described with reference to the embodiments shown in the drawings, it should be understood that the present invention can be embodied in many alternate forms of embodiments. In addition, any suitable size, shape or type of elements or materials could be used.

[0009] The card edge connector assembly 20 mounts to a plurality of contact pads 22 arranged in a contact pattern 23 on an underlying contact surface 24 in the form of a motherboard 26, for example. A planar card 28, a daughter board, for example, has first and second opposed surfaces 30, 32 with conductive contact members 34 on at least one of the opposed surfaces.

[0010] Viewing now also Figs. 2-5, an elongated longitudinally extending outer frame 36 defines a reception region 38 which is adapted to receive a plurality of modules 40. Each of the modules 40 includes contact members (to be described below) and the modules lie side by side in parallel laterally extending planes which, as an assembly, are positioned to connectively engage with the mating contact pads 22 on the underlying contact surface 24. The outer frame 36 includes opposed spaced end walls 42, opposed spaced side walls 44, and a top wall 46 integrally joining the end walls and the side walls. The end walls, side walls, and top wall together define the reception region 38, the top wall having a longitudinally extending aperture 48. The end walls 42 and the side walls 44 extend to a lower rim 50 distant from the top wall 46 and define, interiorly, an opening 52 through which the modules are inserted into the reception region 38.

[0011] Turning now to Figs. 6, 7, and 8A-8D, each module 40 includes an insulative housing 54 which has first and second spaced generally parallel elongated passages 56, 58 therein and a card receiving recess 60 for reception of the planar card 28 (Fig. 1) between the

first and second passages. A first elongated contact 62 is firmly received in a known manner in the first passage 56 and has a first contact surface 64 positioned for engagement with an associated contact pad 22 (Fig. 1) on the contact pattern 23 of the underlying contact surface 24 using known techniques. In a similar fashion, a second elongated contact 66 is firmly received in the second passage 58 having a first contact surface 68 positioned for engagement with another associated contact pad 22 on the contact pattern 23 of the underlying contact surface 24. Although shown as being surface mount contacts, any type of termination (e.g. press-fit, pin-in-paste) could be used.

[0012] As seen in Fig. 1, the card receiving recesses 60 of the plurality of modules 40 integrated as a group within the outer frame 36 define a longitudinally extending card receiving slot 70. Turning back to Fig. 6, the first elongated contact 62 includes a second contact surface 72 projecting into the card receiving slot 70 (or recess 60 of an individual module 40). The second contact surface 72 engages with an associated conductive contact member 34 on the first surface 30 of the planar card 28 inserted into the card receiving slot. In a similar fashion, the second elongated contact 66 includes a second contact surface 74 projecting into the card receiving slot 70 (or recess 60 of an individual module 40) in the direction of the first elongated contact 62. This time, the second contact surface 74 engages with a second one of the conductive contact members 34, this one being on the second surface 32 of the planar card 28 inserted into the card receiving slot.

[0013] With continued attention to Fig. 1, the lower rim 50 of the outer frame 36 includes a cutout region 76 enabling visual inspection of the first contact surfaces 64, 68 of the first and second elongated contacts 62, 66 when engaged with their associated contact pads, respectively. Also, aperture 48 of the outer frame 36 is aligned with the card receiving slot 70 when the plurality of modules are received in the reception region 38.

[0014] Turn now to Figs. 9, 10, and 11 which illustrate opposed ground shields 78, 80, each having a C-shaped cross section for slidable reception, respectively, on an outer peripheral surface 82 of the insulative housing. When so received on the insulative housing, the ground shields 78, 80 are positioned in opposed relationship and in proximate engagement with the outer peripheral surface 82. The first ground shield 78 generally overlies the first elongated passage 56 and the second ground shield 80 generally overlies the second elongated passage 58. The ground shields 78, 80 both include a first integral ground contact 84 for engagement (Fig. 1) with an associated ground contact or pad 86 of an external unit such as the mother board 26. In turn, the ground contact or pad 86 is associated with the mating contact pads 22 engaged by the first contact surfaces 64, 68 of the first and second elongated contacts 62, 66. Further, each of the ground shields 78, 80 includes a second integral ground contact 88 for engagement with an associated ground contact surface 90 on the planar card 28 inserted into the card receiving slot 70. As seen especially well in Figs. 9, 10, and 11, each of the ground shields 78, 80 has a cutout region 92. The cutout region 92 enables visual inspection of the first contact surfaces 64, 68 of the first and second elongated contacts 62, 66 when engaged with their associated mating contact pads 22, respectively, and of the first and second ground contacts 84 when engaged with their respective mating ground contact pads 86 of the external unit or motherboard 26.

[0015] Viewing especially Figs. 8A, 8B, 8C, and 8D, the outer peripheral surface 82 of the insulative housing 54 has first and second opposed major sides 94, 96, respectively, and a first minor side 98 joining the first and second major sides. In a similar manner, the outer peripheral surface 82 of the insulative housing 54 has third and fourth opposed major sides 100, 102 and a second minor side 104 joining the first and second major sides. The first and third major sides 94, 100 are coplanar and the second and fourth major sides 96, 102 are coplanar. By the same token, the first and second minor sides 98, 104 lie in parallel spaced apart planes. The insulative frame 54 also has a first elongated slot 106 spaced from and aligned with the card receiving recess 60 and having an inlet positioned intermediate the first and third major sides, 94, 100. The first elongated slot 106 is generally parallel with the first and second minor sides 98, 104. The insulative frame 54 also has a second elongated slot 107, also spaced from and aligned with the card receiving recess 60 and having an inlet positioned intermediate the second and fourth major sides 96, 102, respectively. The second elongated slot 107 is generally parallel with the first and second minor sides 98, 104 and coplanar with the first elongated slot 106.

[0016] A complete module 40 includes, as earlier described in a more general description, the first and second ground shields 78, 80, and these will now be described more completely as they are mounted on the insulative housing 54. Each ground shield 78, 80 has a C-shaped cross section and has earlier been described as being slidably received on the insulative housing in opposed relationship and in proximate engagement with the outer peripheral surface 82. The first ground shield 78 generally overlies the first elongated passage 56 and the second ground shield 80 generally overlies the second elongated passage 58. The first ground shield 78 has first and second opposed limbs 108, 110 proximately overlying the first and second major sides 94, 96, respectively, and a first side limb 112 proximately overlies the first minor side 98. A first flange limb 114 extends transverse of the first opposed limb 108 and is slidably received in the first elongated slot 106. With this construction, the first ground shield 78 substantially completely surrounds the first elongated contact 62 received in the first elongated passage 58.

[0017] In a similar manner, the second ground shield 80 has third and fourth opposed limbs 116, 118 proxi-

mately overlying the third and fourth major sides 100, 102, respectively. A second side limb 120 proximately overlies the second minor side 104. A second flange limb 122 extends transverse of the third opposed limb 116 and is slidably received in the second elongated slot 107. With this construction, the second ground shield substantially completely surrounds the second elongated contact 66 received in the second passage 58.

[0018] It was earlier explained that the first and second ground shields 78, 80 both include a first integral downwardly projecting ground contact 84 for engagement with a mating ground contact or pad 86 of an external unit such the motherboard 26. As earlier noted, the mating ground contact or pad 86 is associated with the mating contacts 22 engaged by the first contact surfaces 64, 68 of the first and second elongated contacts 62, 66. Also, each of the first and second ground shields 78, 80 includes a second integral ground contact 88 for engagement with an associated ground contact surface 90 on the planar card 28 inserted into the card receiving slot 60.

[0019] As particularly well seen in Figs. 1 and 10, both of the second integral ground contacts 88 of the first and second ground shields 78, 80 project into the card receiving recess 60, with the ground contact 88 of the first ground shield 78 generally facing the ground contact 88 of the second ground shield 80. Further, each of the second integral ground contacts 88 of the first and second ground shields project into the card receiving recess 60 at a location nearer the top wall 46 of the outer frame 36 than either of the second contact surfaces 72, 74 of the first and second elongated contacts 62, 66. In this manner, an early mate, late break, grounding operation can be established. More specifically, this construction serves to establish in a preemptive manner common electrical grounding across the contact interface in advance of other electrical interconnection of the first and second electrical contacts 62, 66.

[0020] Turn now to Figs. 12 and 13 for a description of another embodiment of the invention. In this instance, in place of the pair of opposed ground shields 78, 80 enveloping the insulative housing 54, a single tubular ground shield 128 is slidably received on the insulative housing in proximate engagement with the outer peripheral surface 82. As with the combined pair of C-shaped ground shields 78, 80, the tubular ground shield 128 includes a first pair of integral ground contacts 130, each provided for engagement with a ground contact 86 (Fig. 1) of an external unit or motherboard 26 associated with the mating contacts engaged by the first contact surfaces of the first and second elongated contacts 62, 66.

[0021] The tubular ground shield 128 also includes a second pair of integral ground contacts 132 for engagement with the ground contact surfaces 90 (see Fig. 1) on the planar card 28 inserted into the card receiving slot 70 of the insulative housing 54. In every way, the tubular ground shield 128 operates in the manner of the pair of opposed ground shields 78, 80. This includes the provision of a pair of flange limbs 134, similar to the flange limbs 122, which are mutually opposed and coplanar and are slidably received in the second elongated slots 106, 107 of the insulative housing 54. With this construction, the ground shield 128 substantially completely surrounds each of the elongated contacts 62, 66 received in the passages 56, 58.

[0022] In a preferred construction, again viewing Figs. 6 and 7, the insulative housing 54 is formed with first and second spaced pairs of generally parallel elongated passages therein 56 and 56A and 58 and 58A with an elongated contact firmly received in each in the manner previously described. As previously, each elongated contact has first and second contact surfaces with the construction previously described for mating contact with associated contact surfaces on the motherboard 26 and on the planar card 28.

[0023] In order to hold the modules at defined spaced locations within the outer frame 36, the outer frame may be provided with a variety of locating features at a plurality of longitudinally spaced locations. In Fig. 14, for example, the top wall 46 is provided with a plurality of laterally extending protrusions 136 projecting into the reception region 38 which engage associated modules 40 and maintain them in a spaced side-by-side relationship. In this instance, the spacing between each pair of protrusions is approximately equal to the thickness of a module and adjacent modules are maintained a slight distance apart. Similar constructions are illustrated in Figs. 15 and 16. In Fig. 15, a plurality of similarly spaced upright protrusions 138 are provided on the inside surfaces of the side walls 44. In Fig. 16, a plurality of similarly spaced corner protrusions 140 are provided at the inner interface between the side walls 44 and top wall 46. In each instance, the protrusions 136 or 138 or 140 repeat at the same pitch distances for the entire length of the outer frame 36.

[0024] In other instances illustrated in Figs. 17and 18, each module has complimentary locating features formed for engagement with locating features of the outer frame, again, such that each module is positively positioned with respect to the outer frame. In Fig. 17, for instance, lateral protrusions 142 are illustrated which may be of the nature and longitudinal spacing of the protrusions 136. In this instance, modified modules 40A have a laterally extending groove 144 which matingly receives the lateral protrusions 142 to maintain the modules in a spaced side-by-side relationship with adjacent modules maintained a slight distance apart. In Fig. 18, downwardly extending protrusions 146 are appropriately located to project into the uppermost end portions of the elongated passages 56, 56A, 58, and 58A of the insulative housing 54. This construction is also seen, for example, in Fig. 2. In the same manner as in the previously described embodiments, in this instance, the modules are maintained in a spaced side-by-side relationship with adjacent modules maintained a slight distance apart.

[0025] As seen in Figs. 1, 2, and 3, a septum member 148 may be provided intermediate the spaced end walls 42 and lying in a plane parallel to the end walls. With this construction, the reception region 38 is separated into first and second chambers 150, 152 (Fig 2) for receiving the modules 40. A retention clip 154 may be attached to the septum member 148 at the lower rim, extending away from the outer frame 36 in a direction away from the top wall 46.

[0026] Indeed, a plurality of retention clips 154 may be provided for attaching the outer frame 36 to an underlying surface, for example, to the motherboard 26, one of the retention clips mounted on each end wall 42 and on each septum member 148 at the lower rim 50. In each instance, the retention clip extends in a direction away from the top wall 46 and are secured to the substrate with known techniques.

[0027] In Fig. 19, a modified outer frame 36A is illustrated in which a pair of longitudinally spaced septum members 156, 158 are provided intermediate the spaced end walls 42A. The septum members 156, 158 lie in planes parallel to the end walls 42A and thereby separate the reception region 38A into a plurality of chambers 160, 162, 164 for receiving the modules 40. Each of the septum members 156, 158 includes a registration feature, for example, uppermost edges 166, 168 enabling a modified planar card 28A with conductive contact members thereon (not shown) and complementary registration features 170, 172 to be fully inserted through the longitudinally extending aperture of the top wall 46A and into the card receiving slot. When this occurs, the slotted registration features 170, 172 are positioned and sized for engageable reception, first of the uppermost edges 166, 168, respectively, then the remainder of the septum members 156, 158 so that, in turn, the conductive contact members on the planar card 28A can be mechanically and electrically engaged by the second elongated contact surfaces of the elongated contacts 62, 66 of the plurality of modules.

[0028] Of course, the corollary is true, that if the planar card 28A does not possess the registration features 170, 172 positioned and sized to receive the septum members 156, 158, the planar card would be rejected and incapable of use with the system of the invention.

[0029] When the modules 40 are arranged in side-by-side fashion within the outer frame 36, it may be desirable to provide some further instrumentality, other than those already described, to keep adjacent modules at spaced distances apart. This can be achieved, for example, by providing at least one boss member 174, and preferably several at spaced apart locations on the outer peripheral surface 82 of one insulative housing 54 of a module 40 such that it is, or they are, engageable with the insulative housing of an adjoining module. See Fig. 2. The boss member would be dimensioned to prevent mutual engagement of the ground shield 128 or ground shields 78, 80 of the adjoining modules.

[0030] In an alternative construction, a plurality of mutually opposed pairs of boss members 176, 178 (Figs. 2 and 11) may be provided on the insulative housings of adjoining modules. In this instance, the mutually opposed pairs of boss members are aligned for engagement and dimensioned to prevent mutual engagement of the ground shields of the adjoining modules.

[0031] Recognizing that there are instances in which it is desirable for the ground shields of adjoining modules to be electrically in common, a bridging contact 180 (Figs. 5 and 9) may be provided on at least one of the ground shields of one of the members 40 engageable with the ground shield of its adjoining member.

[0032] Referring now to Fig. 20, there is shown a partial top and longitudinal side perspective view of an alternate embodiment of an electrical connector 200, with a cut-away section, which is attached to a printed circuit board 202. A portion of the top 206 of the housing frame 204 of the connector 200 is shown cut-away from the card edge receiving slot 208 back to one side wall 210. The connector 200 generally comprises the housing frame 204 and connector modules or modules 212, 214, 216 connected to the frame 204. In this embodiment the modules 212, 214, 216 comprise modules from two different families of modules. However, more or less than two families of modules could be provided. In addition, each family of modules could comprise only one or more than one type of different modules as explained in further detail below.

[0033] The frame 204 comprises two module receiving areas 218, 220. However, more or less than two module receiving areas could be provided. In this embodiment the two module receiving areas 218, 220 are separated from each other by a portion 222 of the frame which also comprises a septum member 224. However, any suitable separation could be provided. The first receiving area 218 includes a first array of connector module location features 226. The locating features 226 comprise inward projections along the side walls 210, 211. In alternate embodiments the locating features could comprise recesses and/or could extend downward from the top 206 into the receiving area 218. The first receiving area 218 could also comprise more than one array of locating features. The second receiving area 220 includes a second array of connector module locating features 226. The locating features in the second area 220 are the same as the locating features in the first area 218. However, in an alternate embodiment they could be different. The centerline spacing S between adjacent locating features 226 is also the same in both receiving areas 218; 220, but could be different.

[0034] The first family of modules, in the embodiment shown, comprise the two different types of modules 212, 214. However, the first family could comprise merely one type of module or more than two types of modules. In this embodiment both types of modules in the first family comprise a same housing 228 and same signal contacts 230. However, in alternate embodiments the housings and/or signal contacts for the different types

of modules in the first family of modules could be different. Each housing 228 has an array of positioning features 232 which interlock with at least a portion of the first array of locatinc features 226 in the frame 204. In this embodiment the positioning features 232 comprise grooves or recesses along opposite side walls of the housing 228; one on each side wall. However, in alternate embodiments any suitable array could be provided and the positioning features could have any suitable shape so long as they interlockingly mate with locating features on the frame. In this embodiment, the difference between the two types of modules 212 and 214 of the first family is the presence or absence of a ground shield. The first type of modules 212 comprise ground shields 234 substantially identical to the shields 128 shown in Fig. 12, but the shields 234 can have slots to accommodate the mating locating features 226 and positioning features 232. The second type of modules 214 do not comprise ground shields. In alternate embodiments other features could differentiate the two types of modules 212, 214. The shields 234 of adjacent first type of modules 212 can be formed as differential pair signal and ground contacts for high speed signal transmission. The contacts 230 in the second type of module 214 could merely be ordinary signal contacts for slower speed signal transmission. The first and second types of modules 212, 214 could be intermixed or arranged in any suitable pattern in the first receiving area 218.

[0035] The second family of modules, in the embodiment shown, merely comprises one third type of module 216. However, in alternate embodiments the second family of modules could comprise more than one type module having, for example, different housings, and/or contacts, and/or shielding. In this embodiment the connector 200 merely comprises two of the modules 216, but more or less could be provided. Each module 216 has a housing 236 and contacts 238. The housings 236 each comprise an array of positioning features 240 which interlock with at least a portion of the second array of locating features 226 in the second receiving area 220. In this embodiment the positioning features 240 comprise grooves or recesses along opposite side walls of the housing 236; two on each side. However, in alternate embodiments any suitable array could be provided and the positioning features could have any suitable shape. In this embodiment the modules 216 do not comprise shielding and are not intended for high speed signal transmission.

[0036] With the present invention the first receiving area 218 can have modules from the first family of modules which are separate from the second receiving area 220. The second receiving area 220 can have modules from the second family of modules. In this case, the two families of modules are differentiated from each other by their different housings 228 and 236. However, in alternate embodiments the differentiation among families of modules could be based upon additional features or alternative features. For example, the housings could have different positioning features or different types of contacts. One of the features of the present invention is the ability to configure the types of modules which are located in the first receiving area 218 from a selection of different types of modules in a first family of modules and, the ability for configuration or patterning of the different types of modules from a same family in the same receiving area. For example, only modules 212, only modules 214, or mixtures of modules 212 and 214 could be provided in the first receiving area 218.

[0037] Another feature of the present invention is the ability to configure the connector to have modules from multiple families of modules, or alternatively to have modules from only one family of modules. Fig. 20 shows the connector 200 with modules from two families of modules. However, the connector could alternatively be configured to have modules from only the first family of modules; i.e., without using the modules 216. More specifically, the modules 212 or 214 could be located in the second receiving area 220. This is because the locating features 226 in the first and second receiving areas have the same size and spacing, such that the positioning features 232 can work in the second receiving area. Furthermore, length of the housing 236 is a multiple of the length of the housing 228. In this embodiment the length multiple is 2, however, any suitable multiple could be used. Therefore, in this embodiment, each of the modules 216 can be replaced by two of the modules 212 and/or 214.

[0038] Referring now to Figs. 21, 22a-22c and 23a-23c, additional features of the present invention will be described. Fig. 21 shows a schematic bottom plan view of a housing frame 250 for an electrical connector, for example a card edge connector. In this embodiment the frame 250 has three connector module receiving areas 252, 254, 256. The first receiving area 252 has a main section 258 and a first array of a first type of locating features 260. The second receiving area 254 has a main section 262 and a second array of a second type of locating features 264. The third receiving area 256 has a main section 266 and a third array of locating features comprising a mixture or combination of the arrays of first and second types of locating features 260 and 264. When the arrays overlap, they can form larger third type of locating features 268. In this embodiment the locating features 258, 264 and 268 comprise grooves in the inside surfaces of the side walls 270, 272 of the frame 250. However, any suitable locating features could be provided.

[0039] A first family of connector modules for use with the frame 250 are shown in Figs. 22a-22c. In this embodiment the first family of modules comprises three different types of modules 274, 276, 278. The first module 274 has a first type of housing 280 and first contacts 282. The first housing 280 has positioning features 284 for positioning in a portion of the first array of locating features 260. The first contacts 282 are preferably signal contacts located in two groups 286, 288 with different

contact pitches. The module 276 has a second housing 290 and first contacts 282. The second housing 290 has a same length as the first housing 280 and a same pattern of the locating features 260, but has a different contact pitch (only the pitch equivalent to group 288) for its contacts 282. The third module 278 has a housing 292 with a longer length than the housings 280 and 290, but has a same repeating pattern for its positioning features 284 and only one contact pitch for its contacts 282. The third housing 292 is sized and shaped to substantially precisely fit inside the first receiving area 252. Alternatively, two of the first and/or second types of modules 274, 276 could be located in the first receiving area 252. The first family of connector modules could have different housing lengths and contact positions, but in this embodiment they can all be identified by the size, shape and relative positioning of their positioning features 284.

[0040] The second family of connector modules for use with the frame 250 are shown in Figs. 23a-23b. In this embodiment the second family of modules comprises three different types of modules 294, 296, 298. The first module 294 has a first type of housing 300 and second contacts 302. The first housing 300 has positioning features 304 for position in a portion of the second array of locating features 264. The second contacts are preferably power contacts. The second module 296 has a second housing 306 and a third type of contact 308. The second housing 306 has a same length as the first housing 300 and a same pattern to the position features 304, but merely has a different size and shape hole for the contact 308. The contact is preferably a power contact, but has a different shape from the power contacts 302. The third module 298 has a housing 310 with a longer length than the housings 300 and 306, but has a same repeating pattern for its positioning features 304. The third module 298 has both the first and second types of power contacts 302 and 308. Other members of the second type of family could also be provided, such as having different contacts, housing lengths, or other variations, but they can all be identified by the size, shape and relative positioning of their positioning features 304. Combinations of modules 294 and/or 296 and/or 298 can be used to fill in the second receiving area 254 in the frame 250.

[0041] The locating features 260 in the first receiving area 252 and the locating features 264 in the second receiving area 254 are configured to receive modules from only the first family of connector modules and the second family of connector modules, respectively. The connector modules 294-298 of the second family cannot be inserted into the first receiving area 252 because of the differences between locating features 260 and positioning features 304. Likewise, the connector modules 274-278 of the first family cannot be inserted into the second receiving area 254 because of the differences between the locating features 264 and the positioning features 284.

[0042] The third receiving area 256 is adapted to receive modules from both of the module families. In alternate embodiments the third receiving area might not be provided, or more than one third receiving area could be provided or, one or both of the first and second receiving areas might not be provided. In the embodiment shown, the right side of the third area 256 could receive two of the modules 294 and/or 296. The left side and center of the third area 256 could receive modules 274, 276 and/or 278. In addition, the right side of the third area 256, and/or the center and right side of the area 256, might include one or more of the first- family of modules. This is because the array of first type of locating features 260 overlaps the second array of locating features 264 in the third receiving area 256; allowing the modules 274-278 to be positioned throughout the entire third receiving area 256. After reading the above description, variations in patterns should be easily envisioned by those skilled in the art to produce other obvious embodiments incorporating features of the present invention. More than two different types of positioning and/or locating features could also be used.

[0043] The present invention can allow for a connector frame to be able to receive heterogeneous groups of modular units (s) of sets of various designs and purposes (families) to form electrical connectors. The connector frame can comprise locating features designed to selectively admit subset combinations of families in some predetermined locations while rejecting these subsets in favor of other subsets from a different family. The assembly can comprise subassemblies of identical shielded modular units which can be interspersed with lower cost non-shielded units and/or special-purpose units (such as for high current interconnections). Some positions in the frame could be left blank or could be filled with blank or dummy modules. Sets of frames and modules may be designed with distinct families of position structures and features, whereby these frames, in offering a first set of positioning structures in any one aperture and a mechanically incompatible second and distinct series of positioning structures in any other aperture will prevent the mingling of one family of module designs with a second family of designs within the same aperture. This segregation may be advantageous as a polarity feature, or as a means of eliminating assembly operator error, or to provide a special and proprietary series of product distinct from a general commodity design. An additional advantage of such segregation is the separation and deliberate location of a distinct series of modules of an especially robust design capable of withstanding severe service, such as high voltages, high currents, or exceptional mating life demands, whose special positioning structures are mechanically incompatible with elements from the series of standard service designs. In this case, such segregation can advantageously prevent an undesirable or dangerous condition, including the untimely or catastrophic failure of any improperly positioned standard service unit or group accidentally subjected to severe service.

[0044] It should be understood that the foregoing description is only illustrative of the invention. Various alternatives and modifications can be devised by those skilled in the art without departing from the invention. Accordingly, the present invention is intended to embrace all such alternatives, modifications and variances which fall within the scope of the appended claims.

Claims

1. An electrical connector (200) comprising:

a frame (204) having at least one connector module receiving area (218) adapted to receive a plurality of connector modules (212), wherein the frame (204) comprises a first array of connector module locating features (226) and a different second array of connector module locating features (226);
at least one first connector module (212, 214) located in the at least one receiving area (218), the first connector module having a housing (228) and electrical contacts, wherein the first connector module (212, 214) comprises a mating first array of positioning features (232) corresponding to at least a portion of the first array of locating features (226) in the frame (204); and
at least one different second connector module (216) located in the at least one receiving area, the second connector module having a housing (236) and electrical contacts (238), wherein the second connector module comprises a mating different second array of positioning features (240) corresponding to at least a portion of the second array of locating features in the frame (204).

2. An electrical connector as in claim 1 wherein the frame (204) and the connector modules (212, 214; 216) comprise slots which form a card edge receiving area (70).

3. An electrical connector as in claim 1 wherein the first connector modules (212, 214) each comprise a ground shield (234) and the second connector modules (216) do not comprise a ground shield.

4. An electrical connector as in claim 3 wherein the first and second connector modules (212, 214; 216) are interspersed with each other in the frame (204).

5. An electrical connector as in claim 1 wherein the frame (204) comprises at least two of the connector module receiving areas (218; 220) which are separated and spaced from each other.

6. An electrical connector as in claim 5 wherein the first array of connector module positioning features (232) is located in a first one of the receiving areas (218) and the different second array of connector module locating features is located in a second one of the receiving areas (220).

7. An electrical connector as in claim 5 wherein at least one of the receiving areas (218, 220) comprises both the first and second arrays of connector module locating features (232, 234).

8. An electrical connector as in claim 7 wherein at least one of the receiving areas (218, 220) comprises only the first array (232) of connector module locating features (226).

9. An electrical connector as in claim 6 wherein the frame (204) comprises at least three of the connector module receiving areas (218) which are separated and spaced from each other, and wherein the frame (204 further comprises a different third array of connector module locating features which comprises a combination of the first array and the second array.

10. An electrical connector as in claim 1 wherein the frame comprises a different third array of connector module locating features (256).

11. An electrical connector as in claim 1 wherein the contacts (238) of the at least one first connector module (212, 214) comprises signal contacts and the contacts of the at least one second connector module comprises power contacts.

12. An electrical connector as in claim 1 wherein the first connector modules (212, 214) include different module having different signal contact spacings of their respective contacts (238).

13. An electrical connector as in claim 12 wherein at least two of the first connector modules (212, 214) having different signal contact spacings are located in a same one of the receiving areas (218).

14. An electrical connector as in claim 1 wherein the housings of at least two of the first connector modules in a first one of the receiving areas have a different length.

15. An electrical connector as in claim 1 wherein the locating features (226) and positioning features comprise mating projections and recesses adapted to slide relative to each other into a final position.

16. An electrical connector as in claim 15 wherein the projections and recesses of the second arrays of

positioning features and locating features (226) have a different cross-sectional size than the projections and recesses of the first arrays of positioning features and locating features.

17. An electrical connector as in claim 1 wherein the second connector modules (216) include different types of second connector modules, and wherein at least one of the contacts (238) of a first one of the types of second connector modules has a different size or shape than the contacts of a second one of the types of second connector modules (216).

18. An electrical connector as in claim 17 wherein the different types of second connector modules (216) are located in a same one of the receiving areas.

19. An electrical connector as in claim 17 wherein the housings of the different types of second connector modules (216) have different lengths.

20. An electrical connector comprising:

a frame (204) having a first connector module receiving area (218) and a spaced second connector module receiving area (220), each receiving area (218, 220) being adapted to receive at least two connector modules (212, 214), and wherein the second receiving area (220) is adapted to receive at least two different connector modules (212, 214);
at least one first connector module (212) located in the first receiving area (218); and
at least one second connector module (214) or first connector module (212) located in the second receiving area (220),

wherein the connector (200) can be provided with connector modules (212, 214) in the second receiving area (220) with or without the second connector modules (214).

21. An electrical connector as in claim 20 wherein the frame and the connector modules (212, 214) comprise slots which form a card edge receiving area.

22. An electrical connector as in claim 20 wherein the first connector modules each comprise a ground shield and the second connector modules do not comprise a ground shield.

23. An electrical connector as in claim 22 wherein the first and second connector modules are interspersed with each other in the frame.

24. An electrical connector as in claim 20 wherein the contacts of at least one first connector modules (212) comprises signal contact and the contacts of the at least one second connector module (214) comprises power contacts.

25. An electrical connector as in claim 20 wherein housings (228, 236) of the first and second connector modules (212, 214) have different lengths.

26. An electrical connector as in claims 20 wherein the first connector modules (212) include different types of first modules having different signal contact spacings of their respective contacts.

27. An electrical connector as in claim 20 wherein the frame (204) comprises a first array of connector module locating features (226) in the first receiving area (218) and a second array of connector module locating features in the second receiving area (220), wherein the first connector module in the first receiving area comprises a mating first array of positioning features (240) interlocked with at least a portion of the first array of locating features, wherein the second connector module comprises a second array of positioning features which can be interlocked with at least a portion of the second array of locating features (226), wherein the second array of locating features is adapted to mate with either the first of the second connector module positioning features (232).

28. A method of assembling an electrical connector comprising steps of:

providing a frame (204) having a connector module receiving area (218, 220);
selecting at least two connector modules (212, 214) from a plurality of different types of connector modules, each connector module (212, 214) having a housing (228) and an electrical contact; and
inserting the selected connector modules (212, 214) into the same receiving area adjacent each other, wherein the connector modules (212, 214) and the frame (204) in the receiving area comprise interlocking locating features (226) to stationarily mount the housings (228) to the frame (204).

29. A method as in claim 28 wherein the locating featurtes (226) of the frame (204) comprise two different arrays of connector module locating features (226), wherein the locating features (226) of the at least two of the selected connector modules (212, 214) comprise different arrays of positioning features (232) which respectively mate with the two different arrays of connector module locating features (226) during the step of inserting.

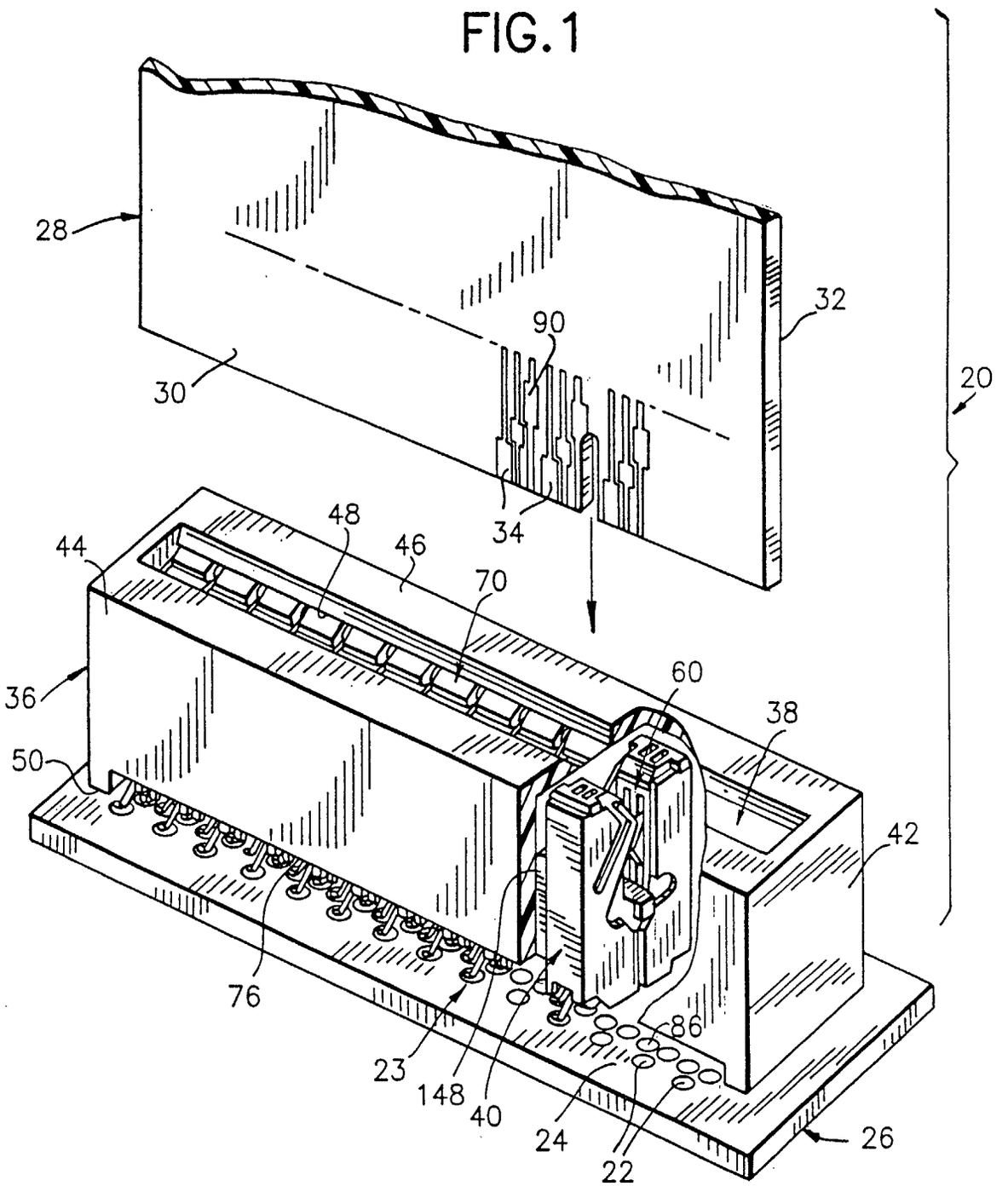
30. A method as in claim 28 wherein the step of selecting comprises selecting a first shielded connector module (212) having signal contacts (230) and a second unshielded connector module having signal contacts (230).

31. A method as in claim 28 wherein the step of selecting comprises selecting a first connector module (212) having signal contacts (230) at a first contact spacing and a second connector module (214) having signal contacts (230) at a second contact spacing.

32. A method as in claim 28 wherein the step of selecting comprises selecting a first connector module (212) having a first housing length and selecting a second connector module (214) having a second different housing length.

33. A method as in claim 28 wherein the step of selecting comprises selecting a first connector module (212) having a first contact (230) with a first size and shape and a second connector module (214) having a different second contact with a second different size or shape.

FIG. 1



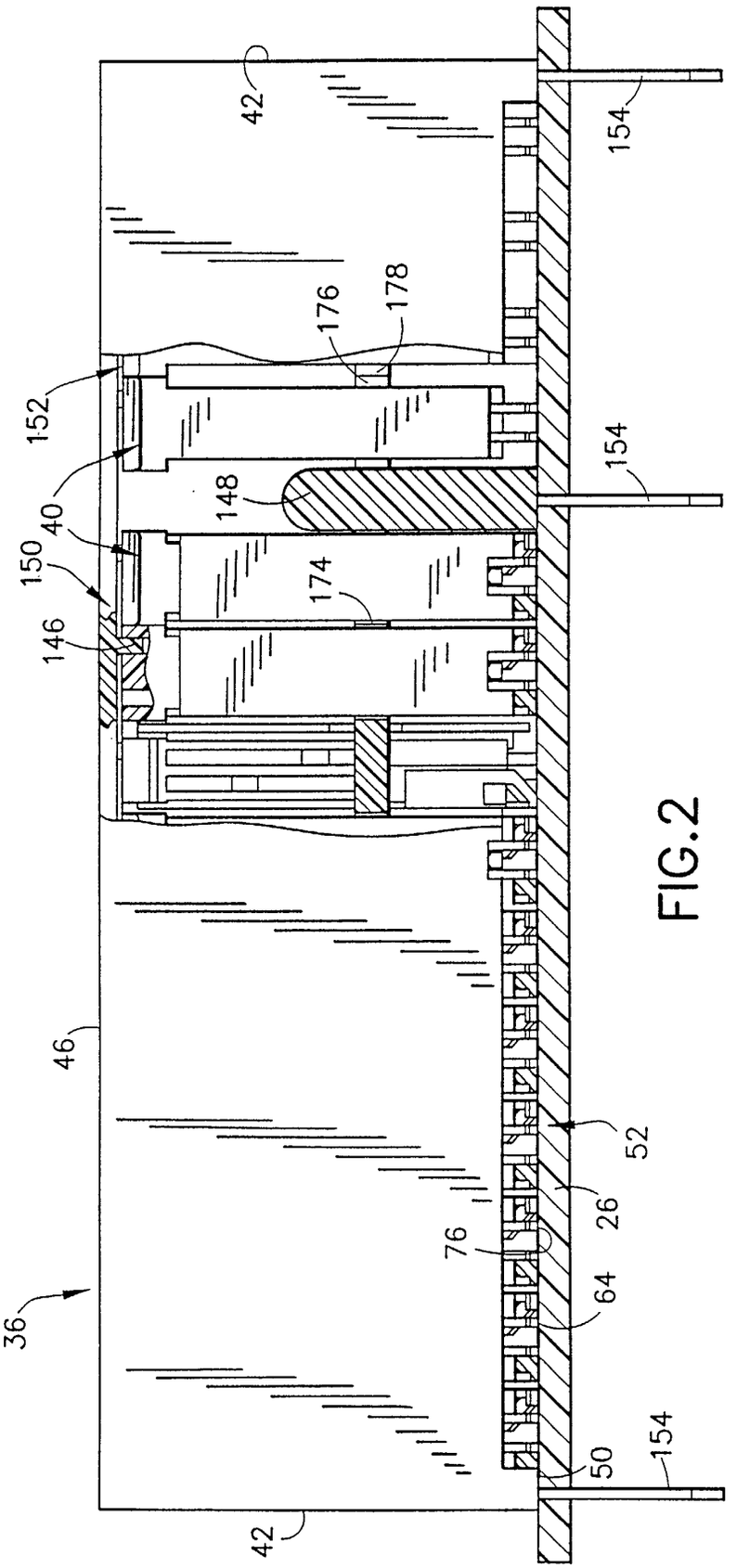

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FIG.2

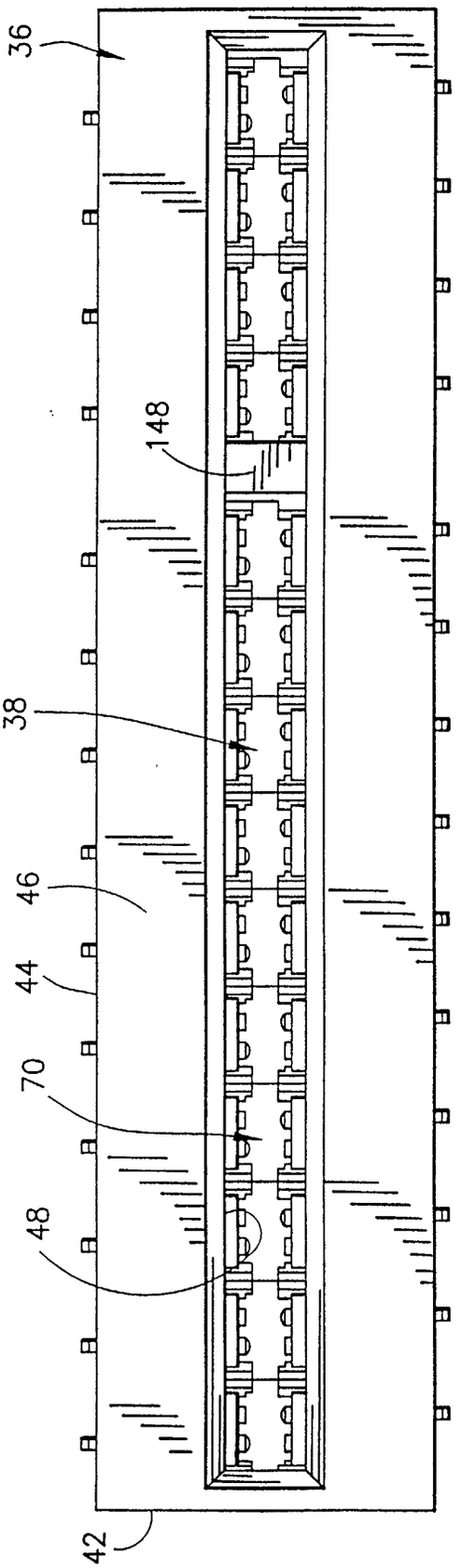


FIG.3

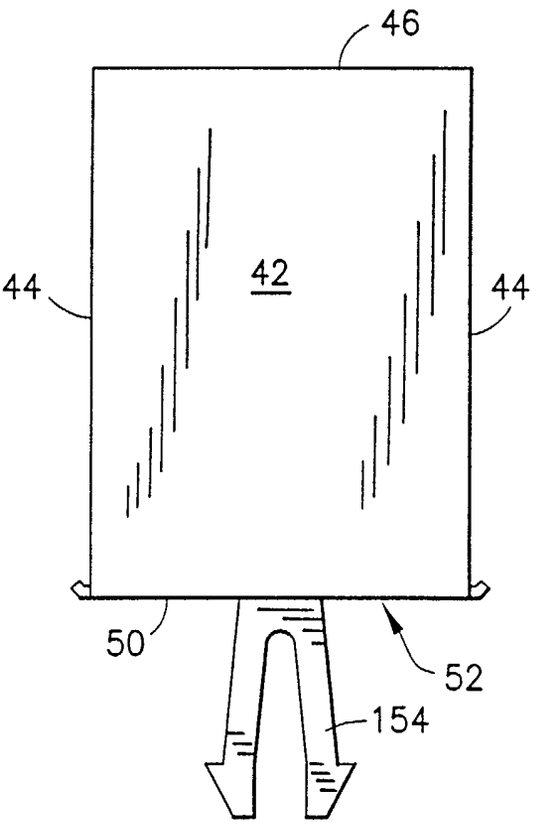
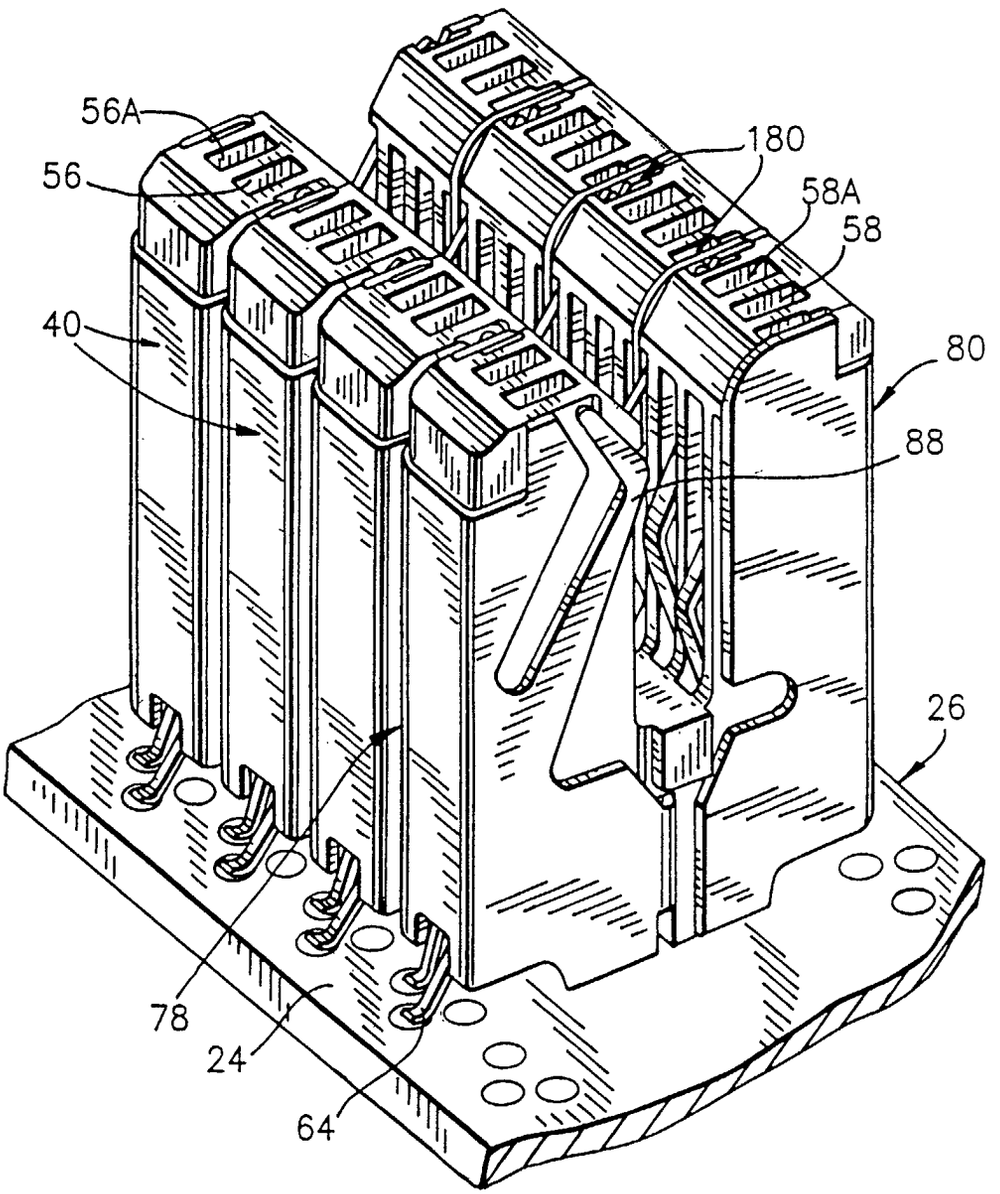
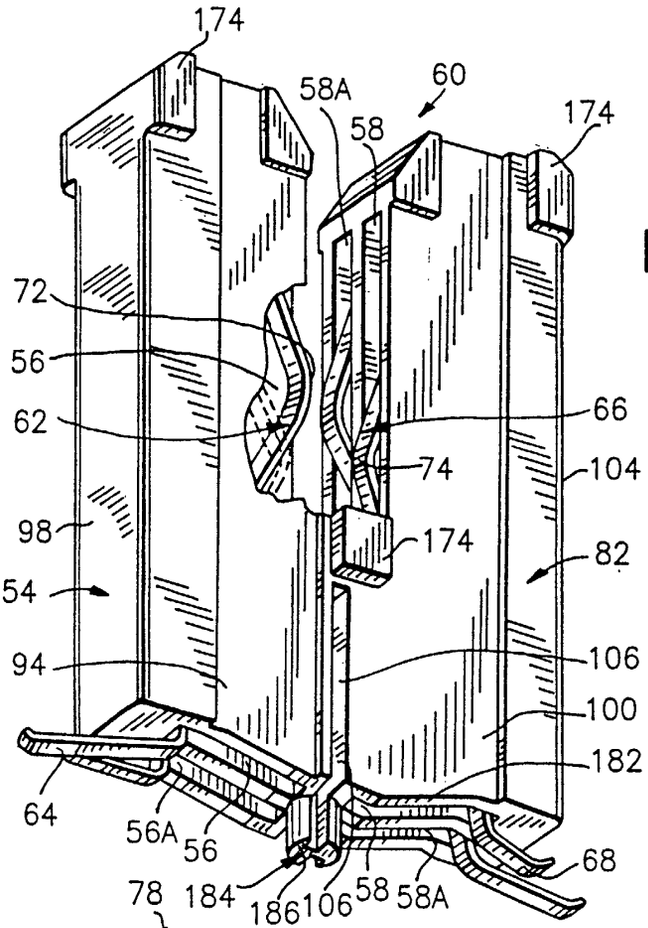


FIG.4

FIG.5

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66
74
104
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106
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56A
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68
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184
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58
58A

FIG.6

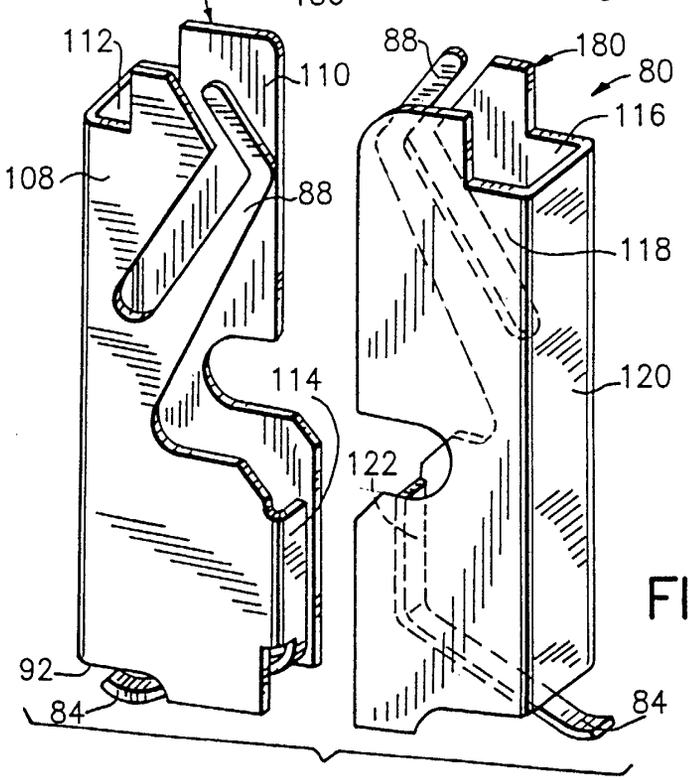
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FIG.9

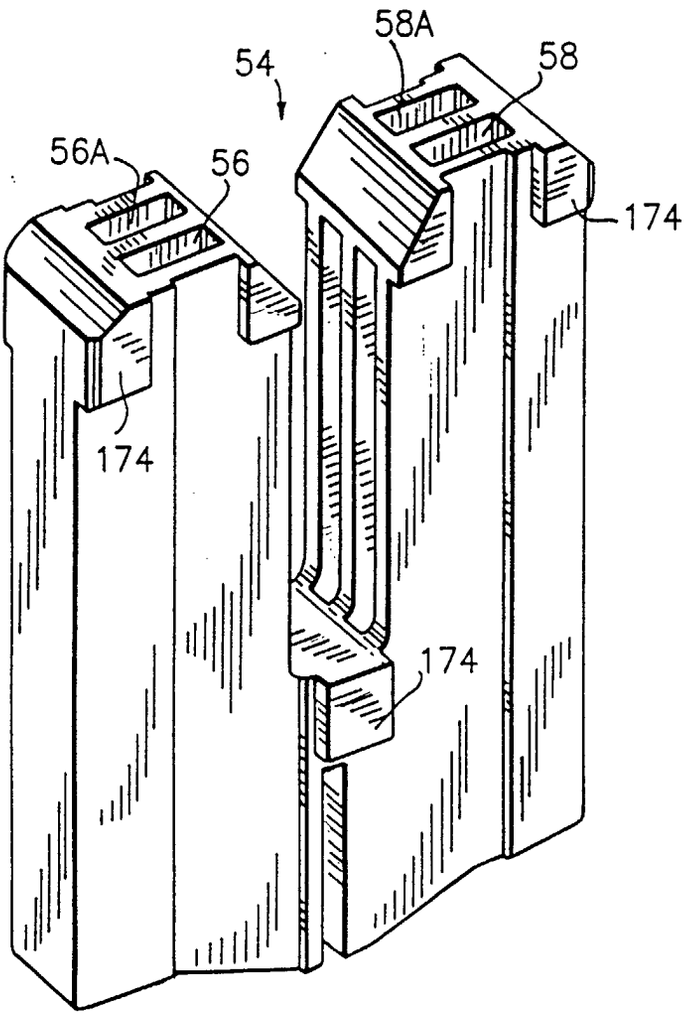


FIG.7

FIG.8A

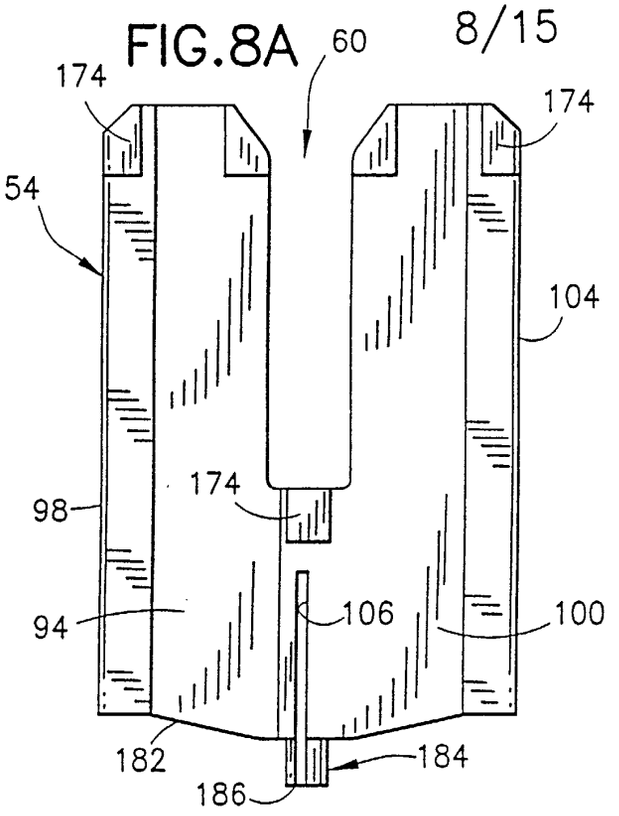


FIG.8B

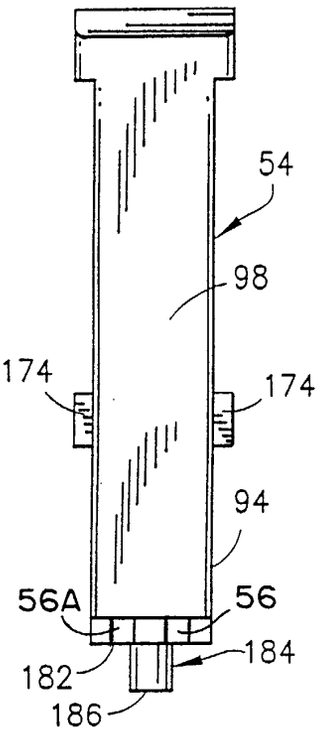


FIG.8C

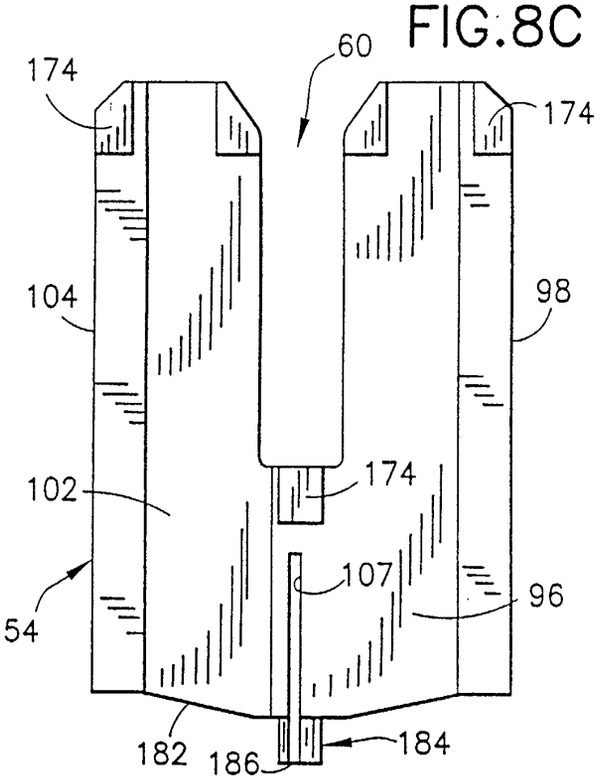
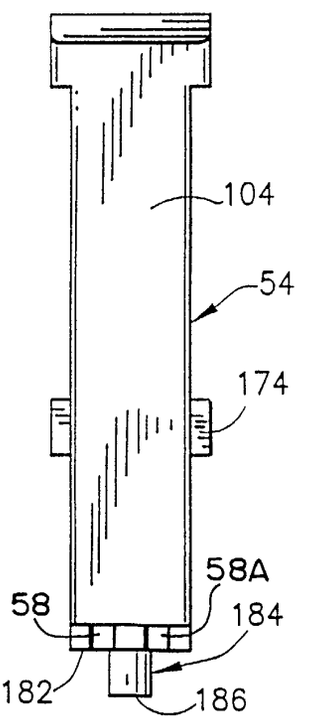


FIG.8D



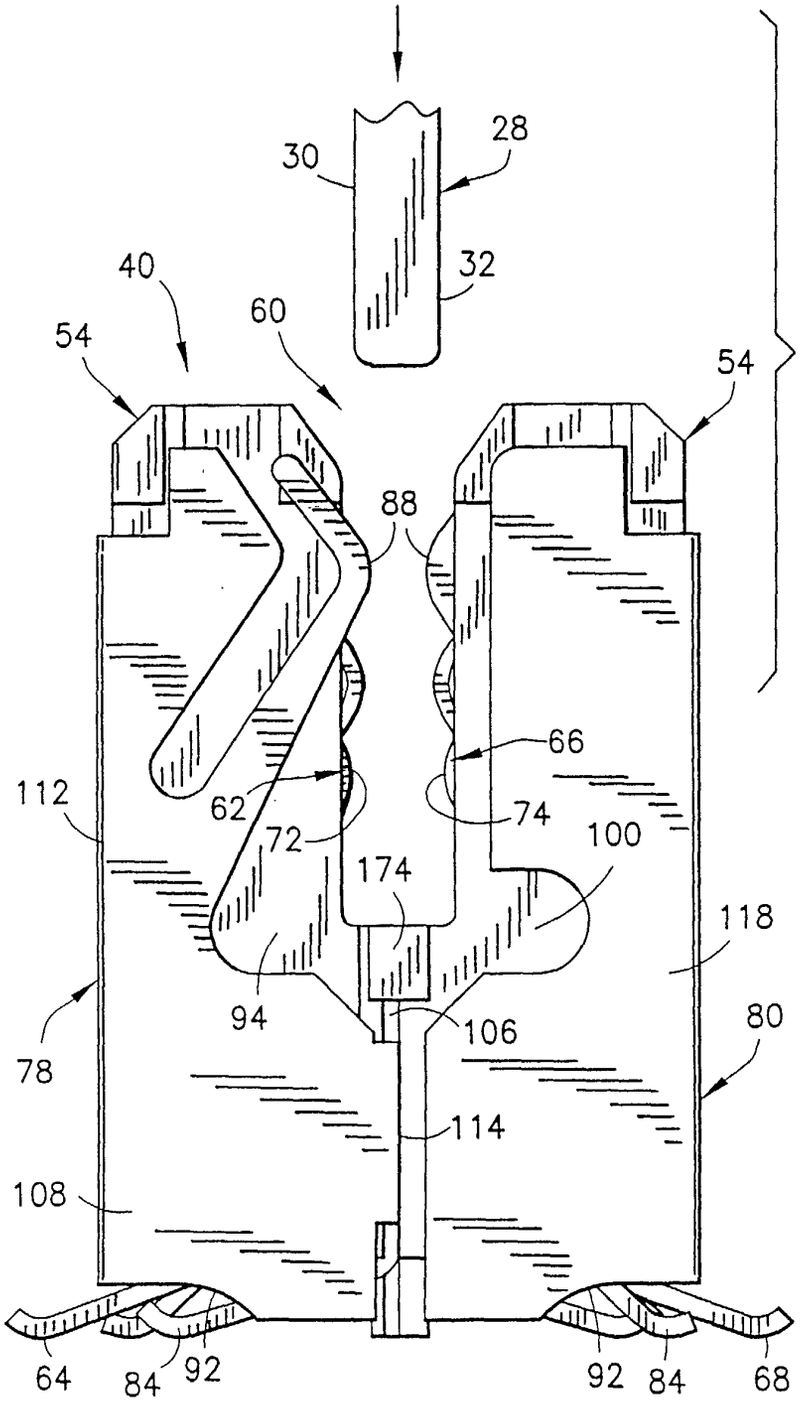

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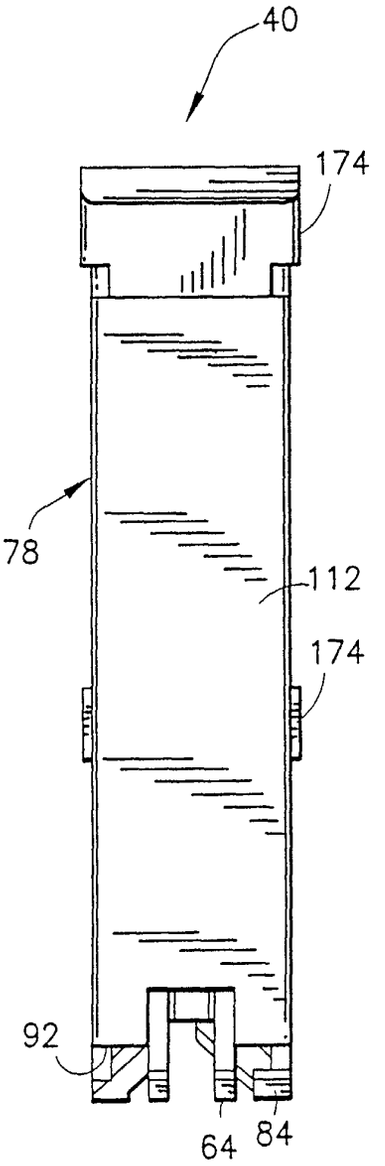
FIG.10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84

FIG.11

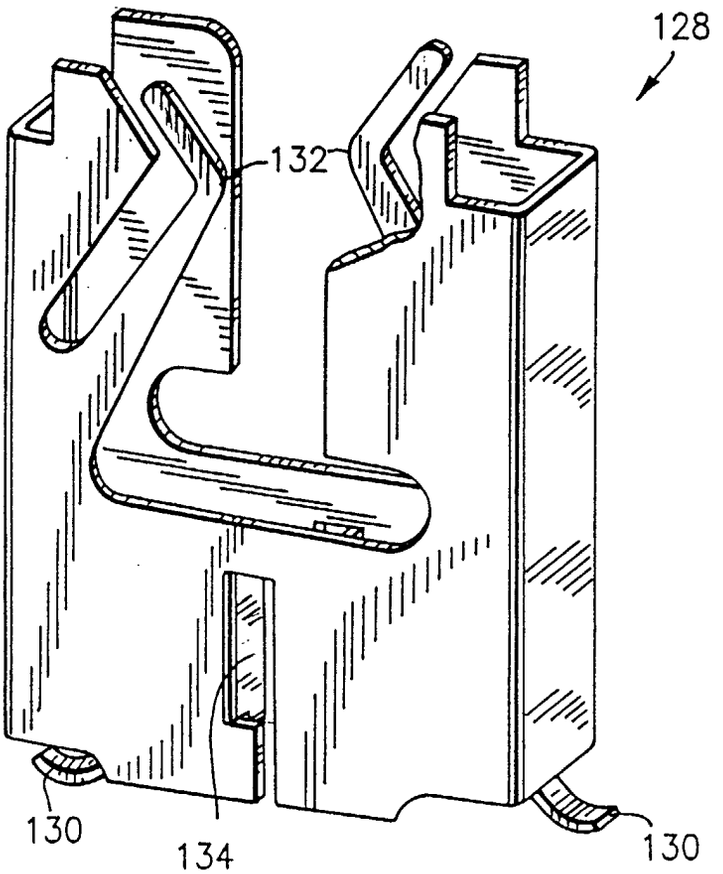


FIG. 12

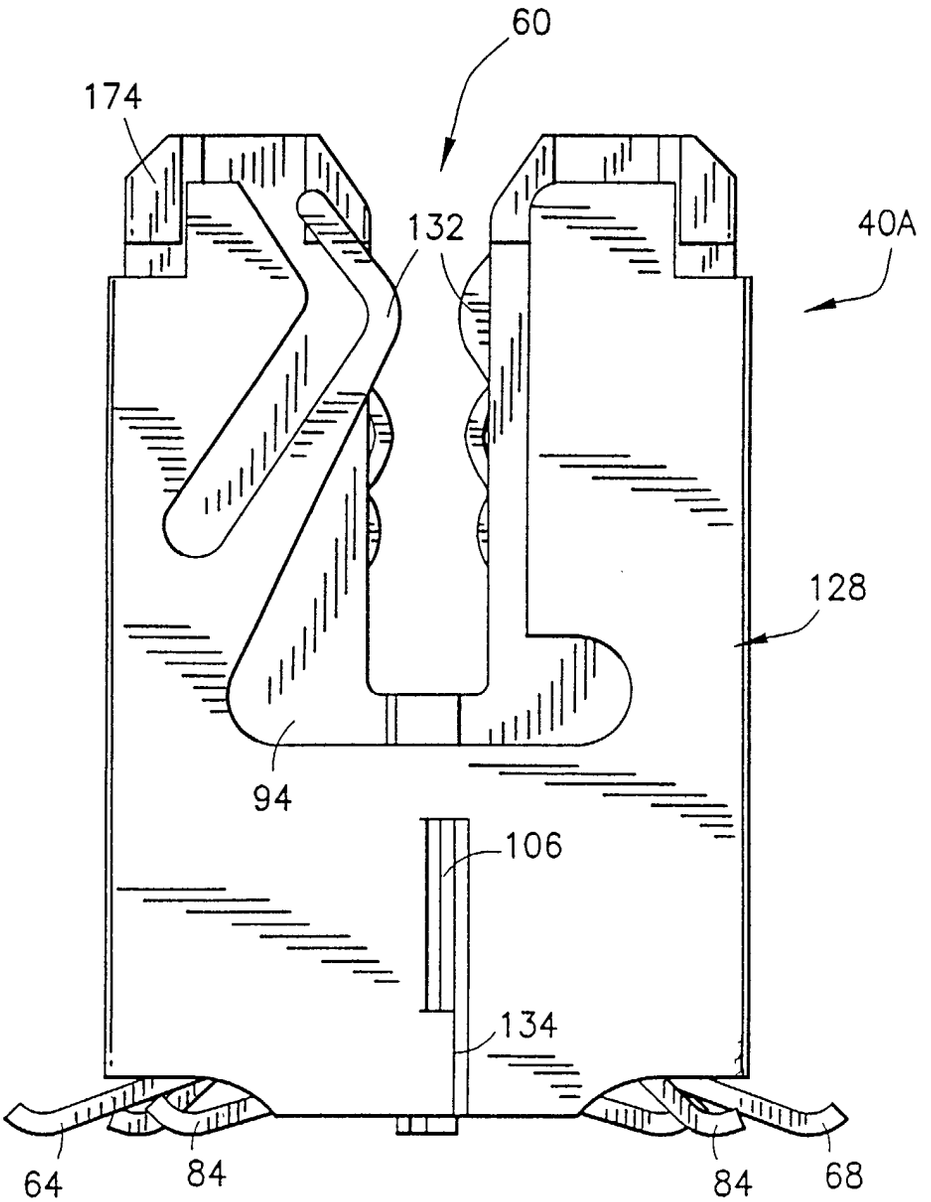


FIG.13

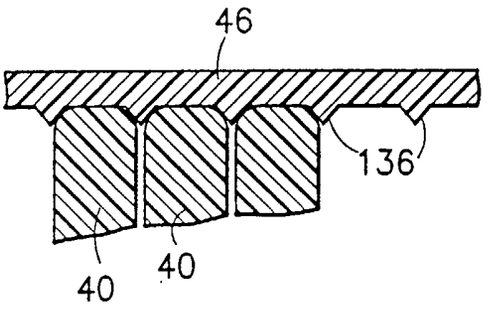


FIG.14

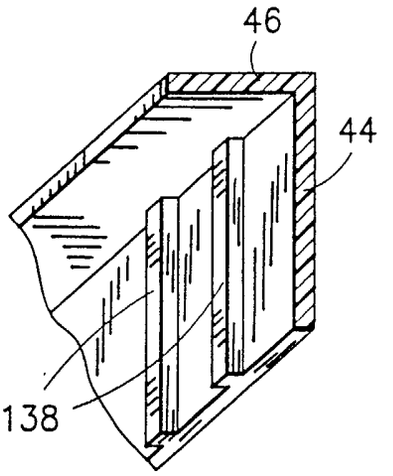


FIG.15

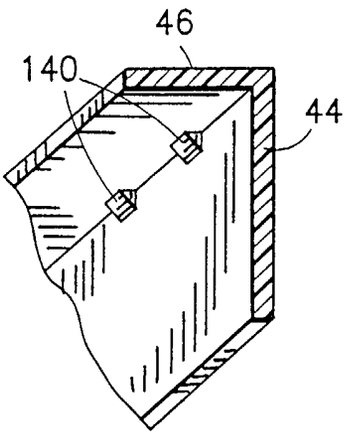


FIG.16

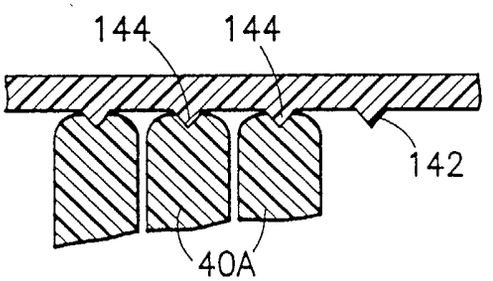


FIG.17

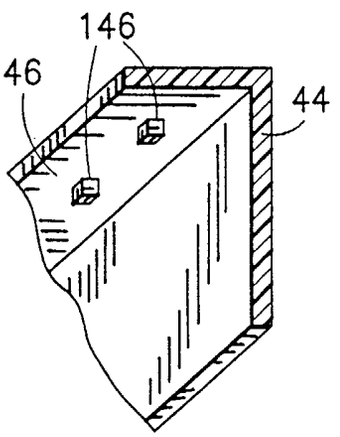


FIG.18

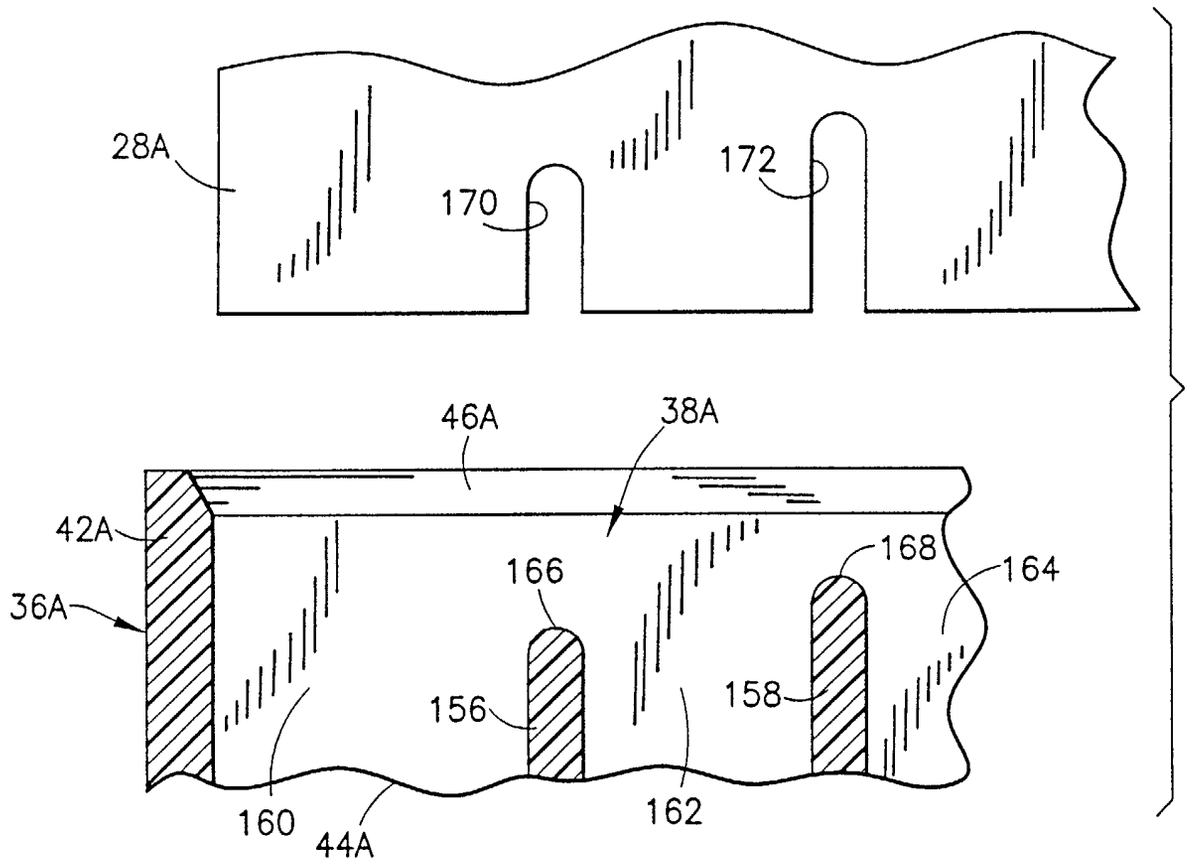
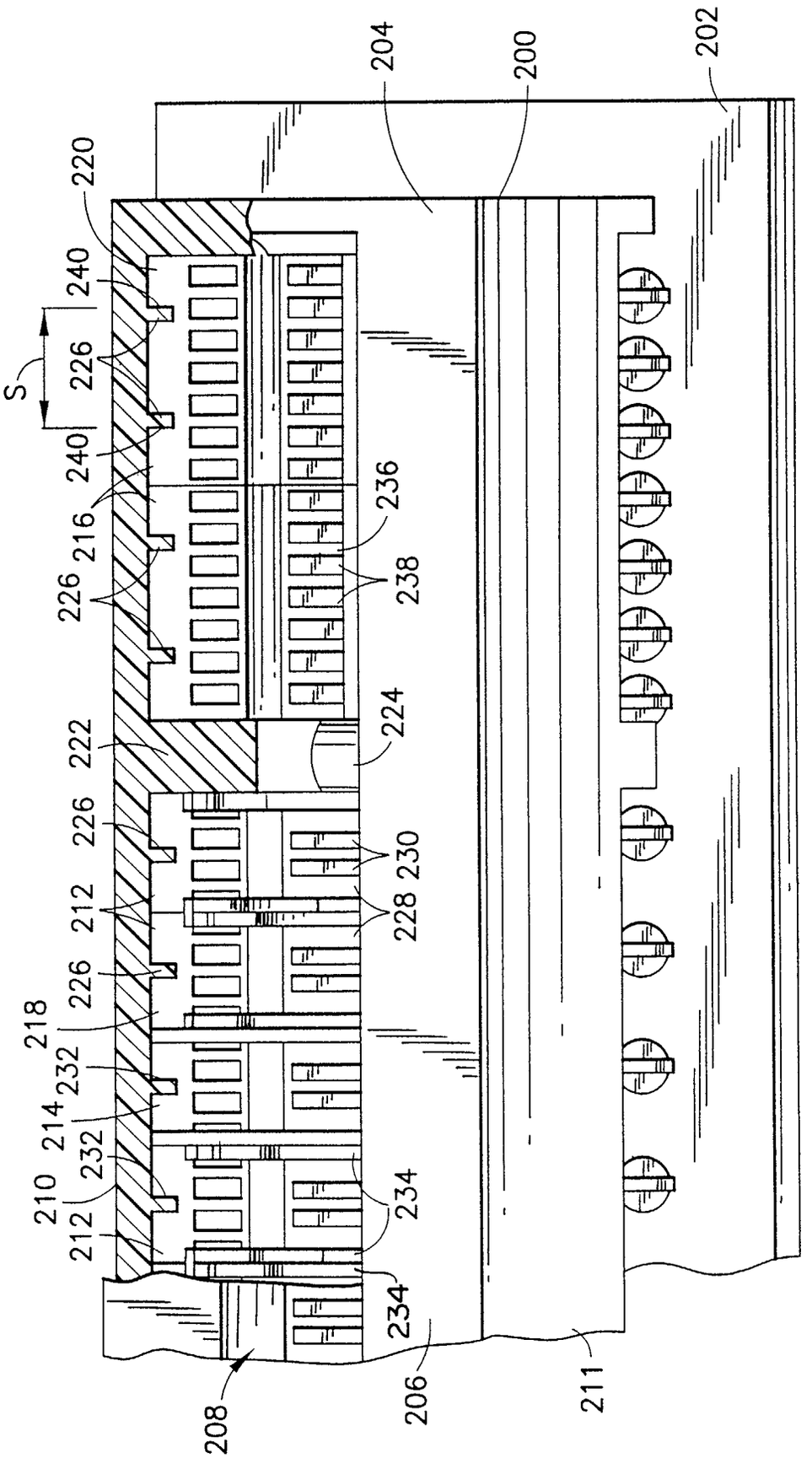


FIG.19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236
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212
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234
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206
211

FIG.20

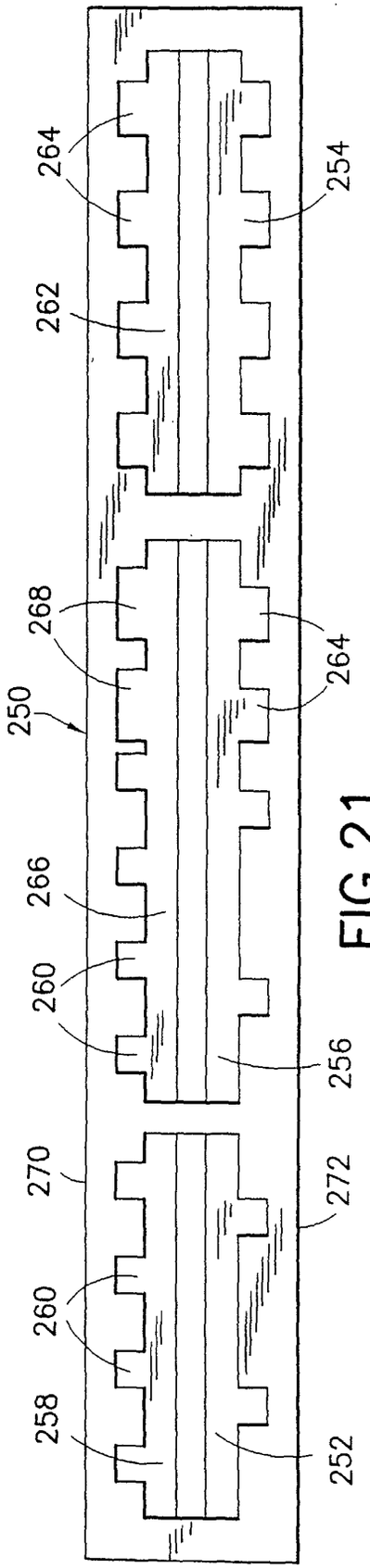

FIG.21

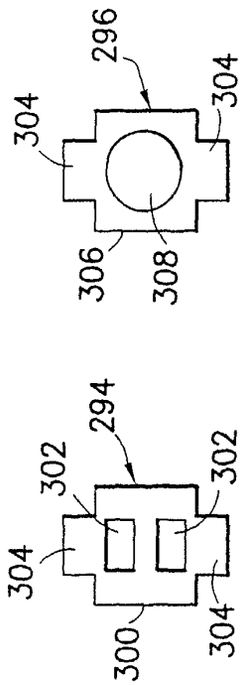

FIG.23b

FIG.23a

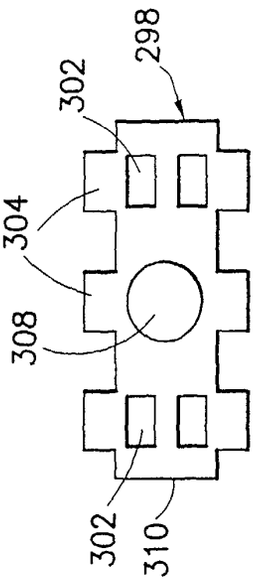

FIG.23c

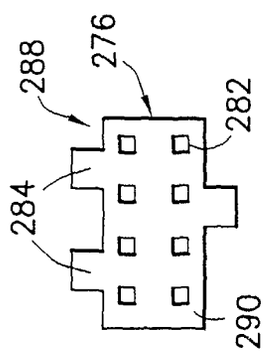

FIG.22b

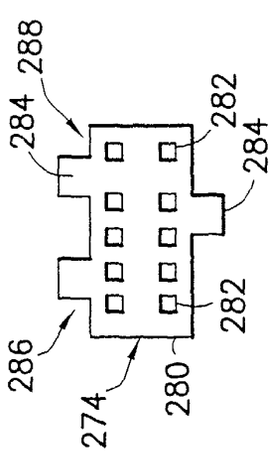

FIG.22a

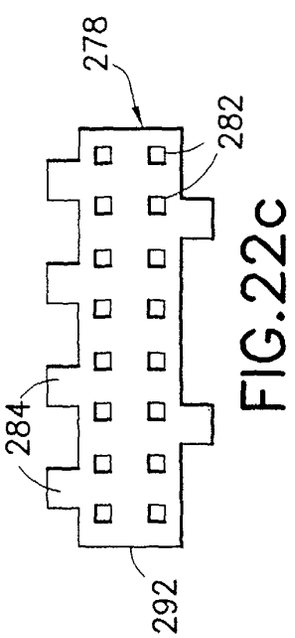

FIG.22c